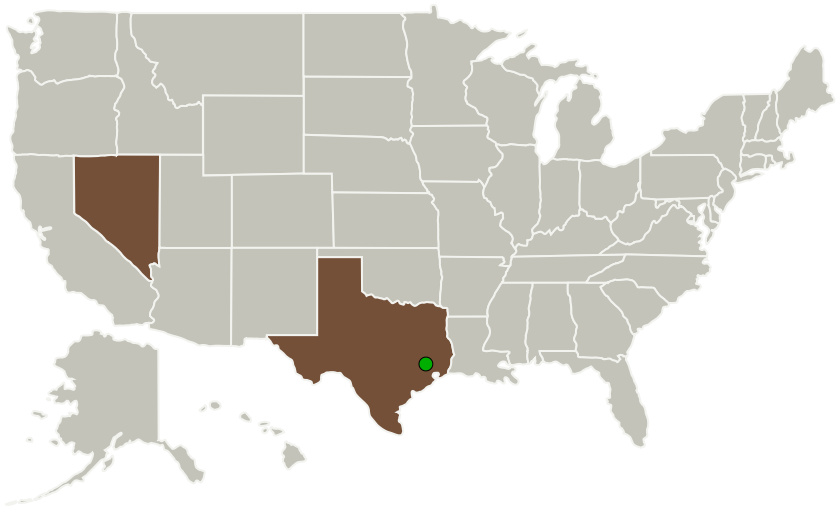
Fail-Safe, Controllable Liquid Spring/Damper System for Improved Rover Space Vehicle Mobility, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

NASA is planning to return to the moon in 2020 to explore thousands of miles of the moon?s surface with individual missions, lasting six months or longer. Surface mobility is critical to outpost buildup and exploration activities, where the change in the vehicle weight between unloaded and loaded cargo conditions and travel over rough terrain can adversely affect the ride handling conditions and vehicle dynamics. The vehicle suspension system components should accommodate for the required range of vehicle weights and provide mobility during various surface activities. In response to NASA?s need to improve surface mobility, an autonomously adaptive liquid spring/damper system is proposed. This system will utilize a compressible fluid, which performs as a liquid spring to eliminate the need for mechanical springs and accumulators, to reduce the overall weight and space requirements of the suspension. The controllable damping force will be utilized by a fluid system that has a fast response time. The system will provide independently controllable damping force on each wheel. Based on our prior work, the proposed system could have a weight saving of more than 20% and size saving of at least 40%. The proposed system is a fail-safe device, i.e., in case of any power interruption or electronic failure, it will retain as a regular passive suspension system component. In this effort, the feasibility of utilizing the proposed system will be demonstrated through testing and multi-body vehicle dynamics model analysis. The proposed system will increase the mobility of the exploration vehicle under different payload (cargo and possible crew) configurations.

Primary U.S. Work Locations and Key Partners



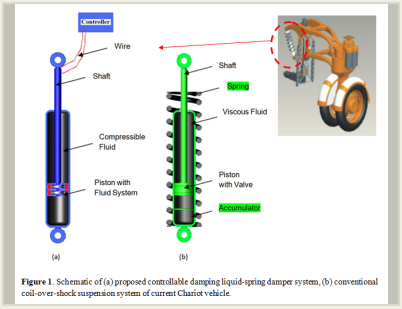


Figure 1. Schematic of (a) proposed controllable damping liquid-spring damper system, (b) conventional coil-over-shock suspension system of current Chariot vehicle.

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Organizations Performing Work	Role	Type	Location
Advanced Materials and Devices, Inc.	Lead Organization	Industry	Reno, Nevada
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Nevada	Texas

Project Transitions

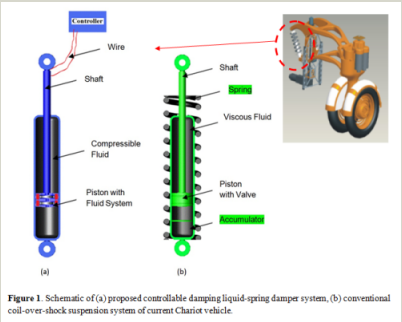
June 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139787)*

Images



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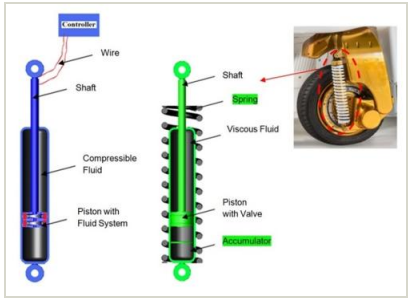
Briefing Chart Image
Fail-Safe, Controllable Liquid Spring/Damper System for Improved Rover Space Vehicle Mobility, Phase I
(https://techport.nasa.gov/image/136895)



Final Summary Chart Image
Fail-Safe, Controllable Liquid Spring/Damper System for Improved Rover Space Vehicle Mobility, Phase I Project Image
(https://techport.nasa.gov/image/136578)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Advanced Materials and Devices, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

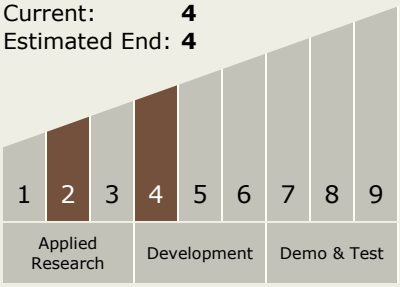
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Barkan Kavlicoglu

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Completed Technology Project (2016 - 2016)

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.2 Mobility
    - TX04.2.4 Surface Mobility

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System